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HISTORY OF THE STELLER SEA LION POPULATION AT AÑO NUEVO ISLAND, 1961–1991

By

Burney J. Le Boeuf, Kathryn Ono
And
Joanne Reiter

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HISTORY OF THE STELLER SEA LION POPULATION AT AÑO NUEVO ISLAND, 1961-1991

by

Burney J. Le Boeuf, Kathryn Ono, and Joanne Reiter
Department of Biology & Institute of Marine Sciences
University of California
Santa Cruz, CA 95064

Final Report

to

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Appendix 1. Principal censusers of Steller sea lions at Año Nuevo Island during the period, 1961-1990. All censusers during the period, 1968-1990, with the exception of K. Ono and C. Calloway, were graduate students of B. Le Boeuf.

ABSTRACT

The aim of this paper is to summarize the recent history and present status of the Steller sea lion colony on Año Nuevo Island, California. Ground censuses were conducted at peak season in July and August during the period, 1961 to 1990. Nine aerial censuses were made, five within two days of ground counts at peak season. Steller sea lion numbers of all censused categories - total females, females with pups, pups and adult males - declined by 85% or more from high censuses in the early 1960's to the lowest counts in 1980. Ground censuses show that pup production in the last decade leveled at 75-125 per year, down from an annual pup production rate of over 700 in 1962. Ground counts underestimated females and pups by 28% and 56%, respectively. The magnitude of the decline in Steller sea lions at Año Nuevo is of the same order as that reported for most parts of Alaska and the Soviet Union during the period, 1956 to 1989.

INTRODUCTION

Despite the difficulties in estimating large numbers of wild animals dispersed over wide areas, it is evident that the total number Steller sea lions, Eumetopias jubatus, in the world has declined significantly over the past 30 years (Merrick et al. 1987). A survey throughout the species' range in 1989 showed that the decline is widespread throughout the area across the North Pacific ocean from the Kenai Peninsula in Alaska to the Kuril Islands north of Japan (Loughlin et al. 1990; Merrick et al. 1990). The greatest reduction has been in the core of the species' range in the Gulf of Alaska and Aleutian Islands where counts have dropped by more than 100,000 animals during the period 1960 to 1990 (Technical draft recovery plan).

The aim of this report is to chronicle changes in breeding season ground counts of Steller sea lions at Año Nuevo Island, from 1961 to 1991, in order to assess the status of the colony. This rookery in central California is the southernmost breeding place in the species' range. Comparison of changes in animal numbers at this colony with that at more northerly colonies in the range may aide in determining the causes of the population decline.

We focus on censuses obtained during the summer breeding seasons, especially those of pups and females, and give less attention to counts made at other times of the year. We emphasize counts made since 1967 by University of California at Santa Cruz scientists and students. Most of the counts were from ground level, but we present aerial censuses when available and compare the two methods.

Background. Sea lions have used Año Nuevo as a breeding or resting

place since at least 1523, when the earliest Spanish explorers noted their presence at this latitude (Wagner 1929). The first systematic counts of sea lions were conducted in the 1920's (Evermann 1921; Evermann and Hanna 1925). Systematic annuals counts under the auspices of the California State Fish and Game continued until the 1970's (e.g., Bonnot 1929; Ripley, Cox and Baxter 1962; Carlisle and Aplin 1971), however, these counts are not useful for our purposes because no distinction was made between Steller and California sea lions, Zalophus californianus. Discrete counts of Steller sea lions were first made in 1961 under a research program funded by the Stanford Research Institute (Orr and Poulter, 1965, 1967); this research program continued until 1966. Representatives of the University of California at Santa Cruz censused the Steller colony during the period, 1967 to 1991 (e.g., Peterson and Gentry 1968; Gentry 1969; Le Boeuf and Bonnell 1980; Le Boeuf 1981; Le Boeuf and Morris 1990).

METHODS

Most counts were conducted from ground level, either from the abandoned lighthouse tower (1961-1975) or from 4-5 blinds located around the perimeter of the island (Figure 1). Binoculars and spotting scopes were used when necessary. In July of 1967 and 1968, precise counts of pups were obtained during tagging operations as adults fled to the water leaving the pups behind on the rookery.

The censuses were conducted by a variety of people over the three decades (Appendix 1). The frequency of censuses, especially during the breeding season, varied with the research priorities of the censuser. During the following periods, in depth studies of the Stellers were in progress and breeding season censuses such as a Master's thesis or PhD thesis were conducted daily or at least three times a week: 1968-1971 - R. Gentry (Gentry 1971); 1974-1980 - R. Gisiner (Gisiner 1985), 1983-1985 - L. Higgins (Higgins 1984). During years when intensive studies were not being conducted, and during the non-breeding season, counts were made at roughly monthly intervals. In some years, the frequency of counts was less than once a month.

During censuses, the following animal categories were distinguished: adult males - large males holding a territory where male territories are traditional; subadult males - roving males without territories many of which usually gathered in certain areas; adult females - females with pups, pregnant females, or large non-parous females; pups - suckling pups or young of the year from June to the beginning of the subsequent breeding season; juveniles - immature animals that include yearlings, 2-4 year old males, and non-parous females. For most analyses, we combined adult and subadult males.

Yearly cycle of island use. In order to compare breeding season

counts to those taken at other times of the year, and to ascertain that the peaks and troughs in numbers observed were consistent over the years, we summarize all counts for four years (1968, 1976, 1983, and 1990) in which the counts were frequent and covered much of the year.

Breeding season censuses. We used the maximum number of females, pups, and males counted in censuses during the breeding season, the interval June through August.

Aerial censuses. Nine aerial censuses were conducted during the breeding season between 1973 and 1990. Most of the photographs were taken from a single or twin-engine aircraft with camera-mount ports on the ventral surface, flying directly above the breeding areas at a height of about 180 m. Three aerial censuses during the period 1973-1975 were sponsored by NASA-Ames and coordinated with ground counts by R. Gentry (Gentry 1971). Bureau of Land Management flights directed by M. Bonnell during the period 1980-1984 were coordinated with ground counts by L. Higgins (Higgins 1984). The aerial census in 1990 was conducted by the Southwest Fisheries Center in association with ground counts P. Morris and associates (Le Boeuf and Morris 1969). Animal categories were identified and counted from large format photographs or color slides projected to a viewing screen.

Colony composition. We looked for changes in colony composition over the years in censuses conducted at the peak of the breeding season, 9 June to 19 July. For this purpose we defined the following categories:

All females - the total number of females counted regardless of their reproductive status.

Females without pups (FWPs) - the difference between the total number of females and the number of pups counted. This difference represents a minimum estimate of the number of females without pups utilizing the island.

Males - the total number of males which includes territorial adults, non-territorial adults, and all classes of subadult males.

Pups - young of the year up until the next breeding season at which time they are called juveniles.

The proportion of the total colony count accounted for by each group was calculated for each census.

RESULTS

Yearly cycle of island use. Figures 2-5 show the censuses of total animals, pups, females and breeding-age males throughout the season

for the years 1968, 1976, 1983, and 1990. These figures make three points: 1) Numbers seen during the breeding season months of May through August were up to 15 times greater than at other times of the year; 2) Peak censuses and the peak period of pup production occurred at approximately the same time of year over the years despite marked declines in counts; the highest censuses were obtained during the period, June 19 to July 29; 3) Censuses of all animal categories decreased from 1968 to 1990, the percentage decline being approximately 70% for females and pups; 4) Counts in 1983 were lower than in 1990 perhaps owing in part to the intense El Niño Southern Oscillation which made feeding difficult for many Pacific coast pinnipeds (Trillmich and Ono 1991); 5) Beginning in the early 1980's, Stellers ceased to be present on Año Nuevo Island at all times of the year; the 1990 census shows that they were absent from about December to March.

Breeding season censuses. Counts of Steller sea lions during the peak of the breeding season at Año Nuevo Island declined steadily from highs in the early 1960's to all time lows in the mid-1980's (Figure 6-9 and Figures 2-5). The percentage decline from high to low census was 85% for total animals (Figure 6), 93% for females (Figure 7), 89% for pups (Figure 8), and 84% for breeding age males (Figure 9). The rates of decline for each census category are similar.

The lowest counts for each animal category, using ground censuses only, occurred in the following years: total animals - 1983, females - 1987, pups - 1985, and males 1981.

The most recent census shows a leveling of the decline in numbers and even a slight upward trend (not tested for significance). For females, pups and adult males, the 1990 censuses were slightly higher than previous censuses in 1986 and 1987 (Figures 7, 8 and 9).

Female numbers peaked during the period, 21 June to 29 July (Figure 3). Pup numbers peaked around 8 August, at least during the later years (Figure 4). Male numbers were highest between 19 and 27 June and fell off steeply after 11 July (Figure 5).

Ground vs. aerial censuses. The data in Table 1, for ground and aerial censuses taken within two days of each other, shows that ground censuses always underestimated the number of females and pups present. The percentage underestimate for females ranged from 21 to 35% (mean = 28%); the range of underestimation was even greater for pups, 53 to 65% (mean = 56%). In contrast, aerial counts of males either underestimated the number present by 53 to 217% or the counts were quite close. The similarity of the totals for the two censuses in 1974, when male counts were most discrepant, suggests that some males were mistaken for females from aerial photographs. The data on juveniles are not clear and we suspect that distinguishing juveniles from the air is difficult.

These data suggest that ground counts of females and pups were underestimated by 28 and 56%, respectively.

Changes in colony composition. The proportion of all females censused, females without pups, pups, and males, relative to total animals varied widely over the study period (Table 2, Figure 10). All females, including females without pups, made up as much as 75% and 64% of the colony, respectively, in the mid-1970's. Total females decreased in proportion to total animals over the last 10 years making up 56% of the colony numbers in 1990. During the same period, the proportion of males increased from a low of 10% in 1980 to 28% in 1990.

Figure 11 shows that the proportion of females with pups did not change significantly over the last 30 years as the colony number declined. Figure 12 shows that total females, pups and males have declined at similar rates.

Changes in spatial distribution. Concomitant with the decline of colony number over the years was a change in spatial distribution of the animals on the island (Figure 13). Observations in the early 1960's to 1977 show five major breeding areas on the southwest seaward side of the island (Figure 11a); two additional sites were used in some years and not in others during the period, 1967-1977. During the period, 1978 to 1983, the Stellers abandoned the most southerly area and another area on the west side (Figure 11b). Most recently, the animals abandoned an area on the island that had formerly been the study area for most behavioral investigations (Figure 11c). The present breeding areas are restricted to the outer islets, the areas furthest from the island and those that are most difficult to census from the ground.

DISCUSSION

This review shows that the Steller sea lion population at Año Nuevo Island has declined markedly since the early 1960's. The decline was greatest during the period ranging from the mid-1960's to about 1980. The percentage decline from the high censuses in the early 1960's to the low counts in the 1980's is 85% or more. All animal categories - adult males, females and pups - showed a similar rate of decline.

Censuses during the last decade suggest that the decline has moderated and that colony numbers have reached a plateau. However, the impact of the El Niño southern oscillation in 1983 makes this recent trend difficult to interpret (Trillmich and Ono 1991).

The magnitude of the decline in Steller numbers at Año Nuevo is on the same order as that reported for most sites in the Soviet Union and Alaska over the period, 1956 to 1989 (Steller Sea Lion Recovery Plan; Federal Register, 1990, Vol. 55, No. 66, 12645-12662). This

coincidence indicates that the decline in the population has occurred throughout the species' range (with few exceptions such as Southeastern Alaska) and over a broad and distant geographic range.

The precipitous decrease in Steller numbers at Año Nuevo also indicates that the breeding range is being reduced. This conclusion is supported by the decline of Stellers in the southern part of the state beginning in the early part of this century. Until just a few years ago, the southernmost rookeries in the Steller breeding range were in the Channel Islands (Bonnot and Ripley 1948). Over 2,000 animals were counted on San Miguel, Santa Rosa and Santa Cruz islands in 1938. In subsequent years, only San Miguel Island was used (Odell 1971; DeLong 1975). In 1975, only 4 adult males, 12 females and 3 pups were sighted on this island (Bonnell et al. 1978). The last Steller pups were seen on San Miguel Island in 1977 (Bonnell et al. 1978; Antonellis and Fiscus 1980).

There have been no obvious changes in colony composition over the last three decades indicative of the causes of the decline.

It is evident from comparison of aerial and ground censuses that the latter underestimate the number of females and pups present.

ACKNOWLEDGEMENTS

Many people conducted censuses at Año Nuevo Island over the last three decades and we are grateful to all of them. Without their time and effort, there would be no report of this species' plight. We are especially indepted to M. Bonnell, R. Gentry, R. Gisiner, L. Higgins, P. Morris and P. Thorson. Some of the research in this report was financed by the Bureau of Land Managment, the Southwest and Northwest Fisheries Science Centers of the National Marine Fisheries Service, and, indirectly, grants from the National Science Foundation.

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Appendix 1. Principal censuser of Steller sea lions at Año Nuevo Island during the period, 1961-1990. All censusers during the period, 1968-1990, with the exception of K. Ono and C. Calloway, were graduate students of B. Le Boeuf.

Year(s)	Principal Censusers
1961-64	R. Orr, T. Poulter
1967	R. Peterson
1968-71	R. Gentry
1972	R. Whiting
1973-	K. Ono, C. Calloway
1974-80	R. Gisiner, M. Pierson, M. Bonnell, K. Briggs, M. Reidman
1981-85	R. Condit, L. Higgins
1986-90	P. Morris

Table 1. Aerial censuses and ground-truth counts taken within two days of each other for Año Nuevo Island, during the period 1974-1990. The percentage change from aerial to ground is shown in parentheses.

Date	Type	Males	Females	Pups	Juveniles	Total
5/16/74	aerial	49	85	0	0	134
5/18/74	ground	75(+53)	58(-32)	0	0	133(-1)
6/26/74	aerial	48	625	199	0	872
6/26/74	ground	152(+217)	467(-25)	93(-53)	11 (+100)	723(-17)
6/29/83	aerial	60	259	193	0	512
6/29/83	ground	54(-10)	169(-35)	106(-45)	3 (+100)	332(-35)
7/6/83	aerial	55	182	258	29	524
7/5/83	ground	50(-9)	143(-21)	95(-63)	4 (-86)	292(-44)
7/11/90	aerial	- -	- -	318	- -	- -
7/11/90	ground	108	199	111(-65)	1	419

Figure 1. A schematic map of the principal features of Año Nuevo Island showing the location of the tower and blinds and some areas referred to in this report. Adapted from Orr and Poulter 1967.

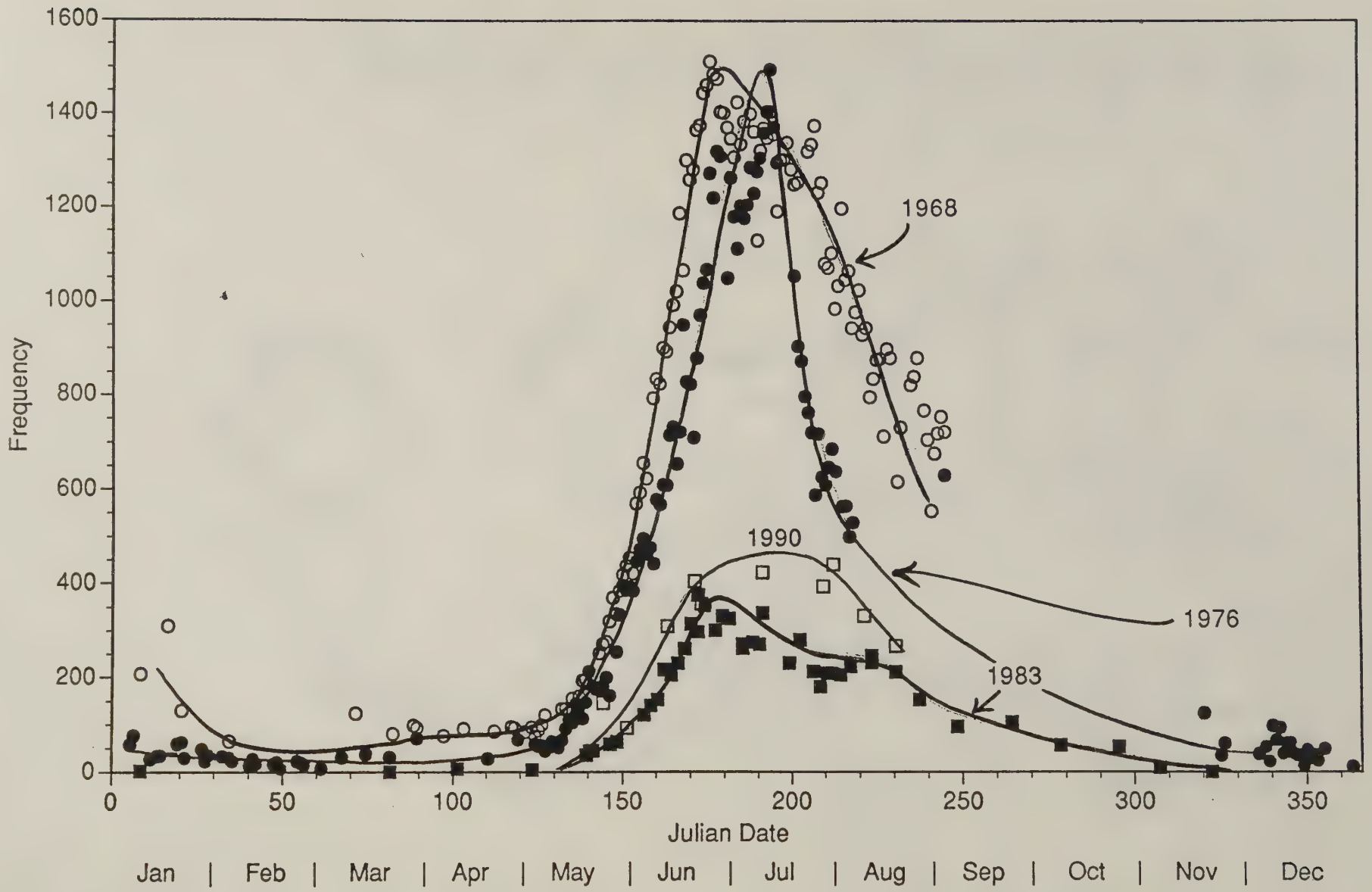

Figure 2. Annual cycle of census counts of all Steller sea lions at Año Nuevo Island, including pups, for the years 1968, 1976, 1983 and 1990.

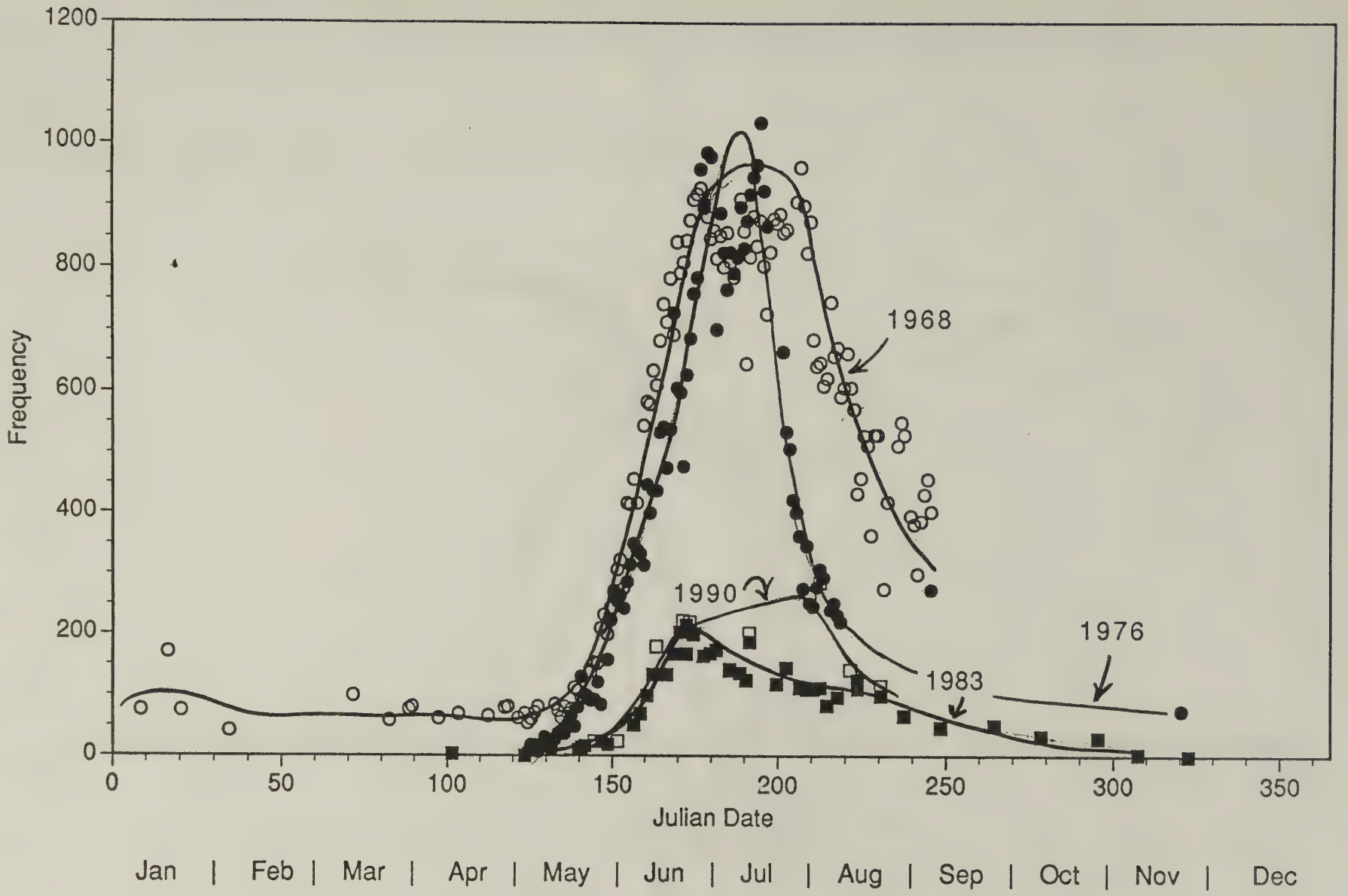

Figure 3. Annual cycle of census counts of all Steller females at Año Nuevo Island for the years 1968, 1976, 1983 and 1990.

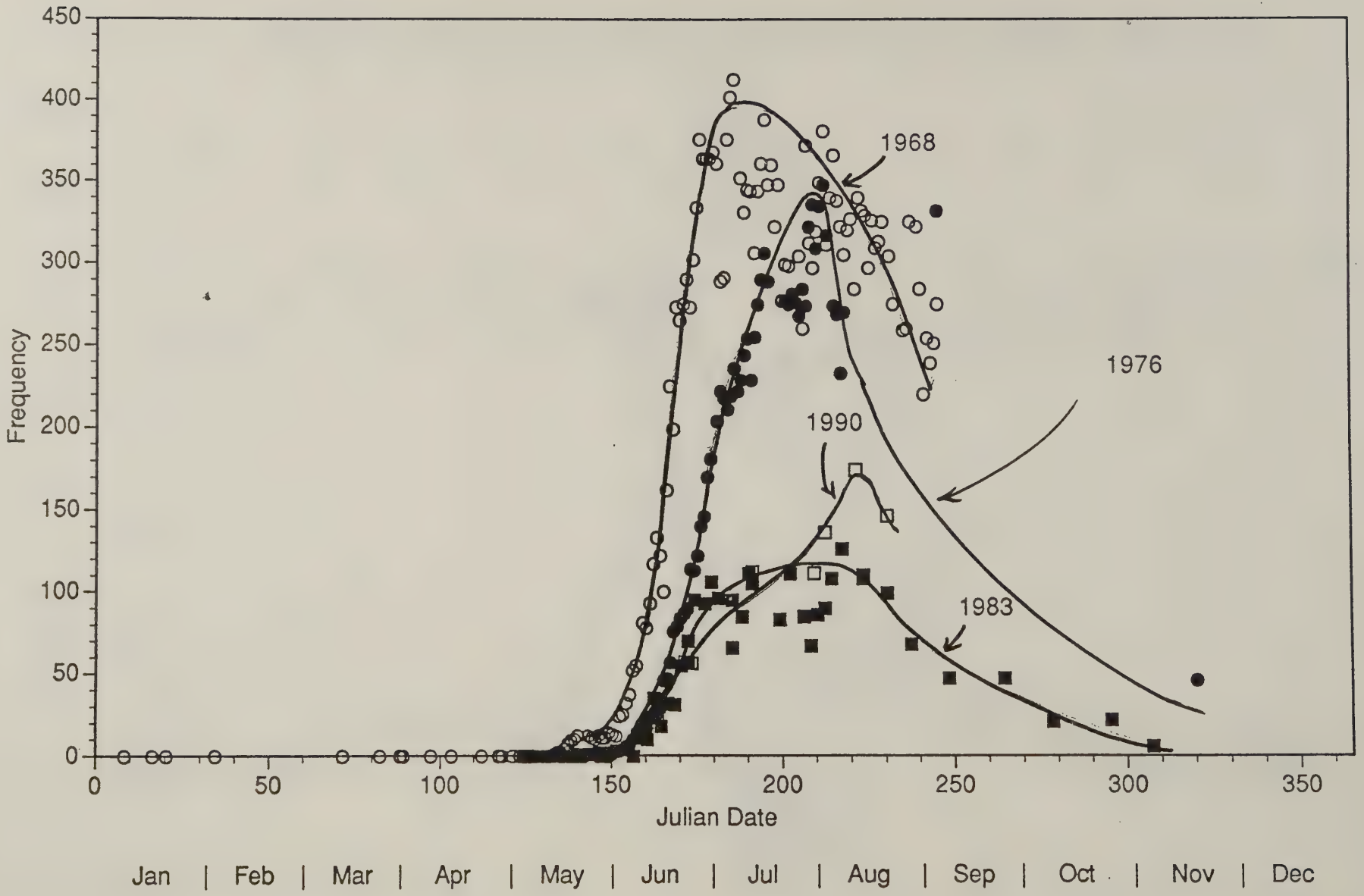

Figure 4. Annual cycle of census counts of all Steller pups at Año Nuevo Island for the years 1968, 1976, 1983 and 1990.

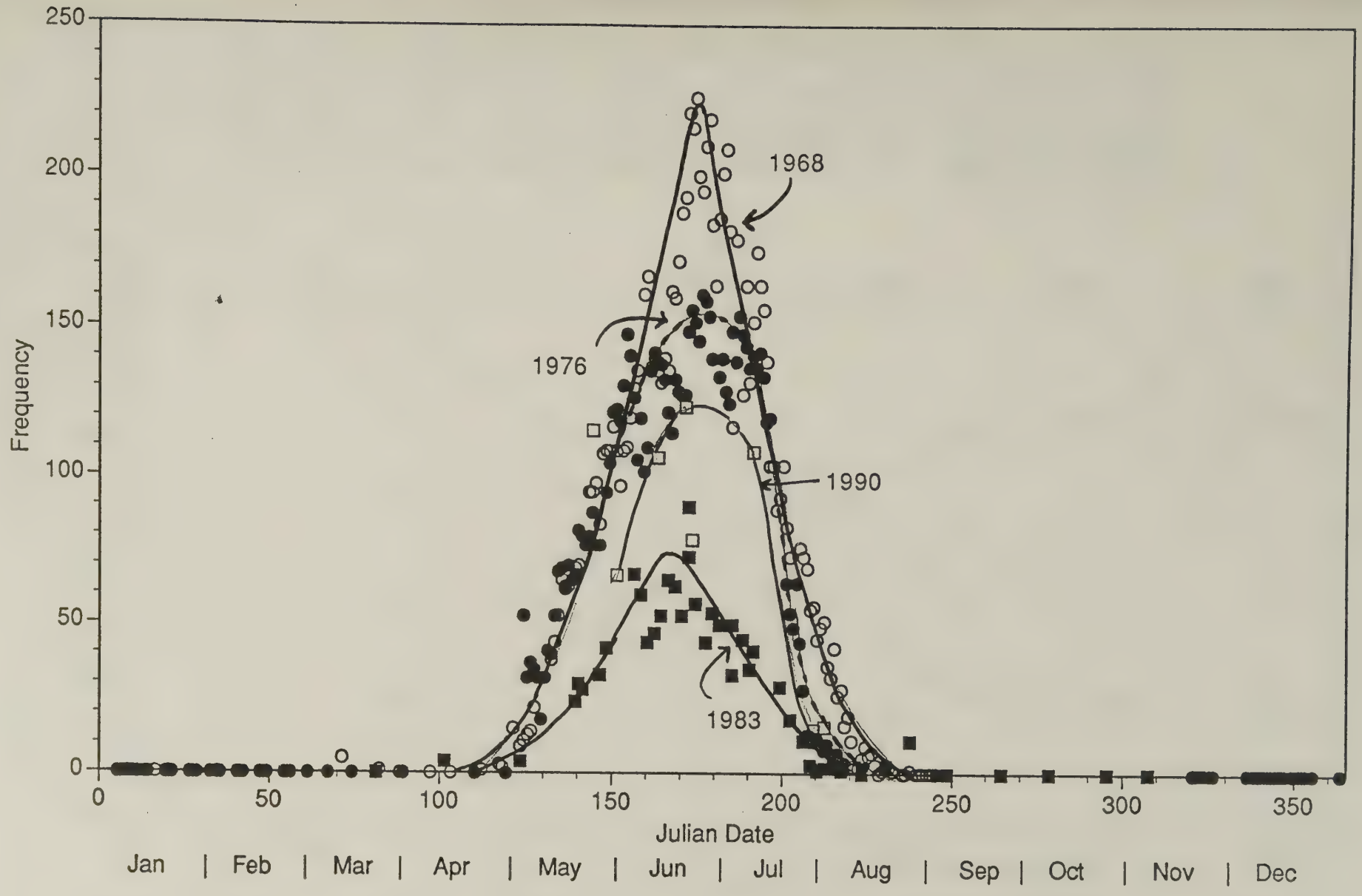

Figure 5. Annual cycle of census counts of all Steller males at Año Nuevo Island for the years 1968, 1976, 1983 and 1990.

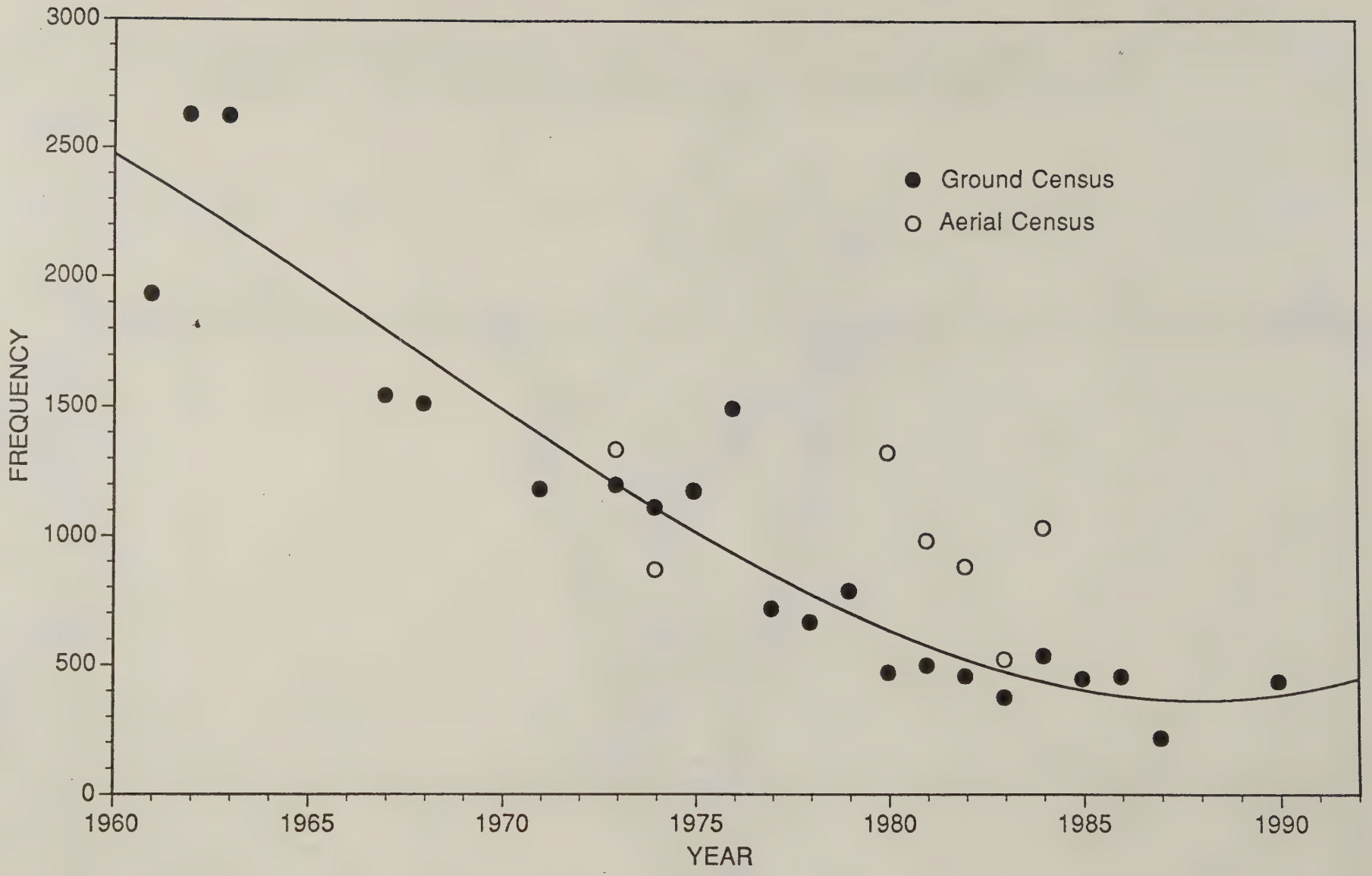

Figure 6. Peak breeding season counts of total number of Steller sea lions on Año Nuevo Island, including pups, for the period, 1961-1990. All censuses were ground counts obtained during the months of June, July or August. Censuses for the period, 1961-1963, are from Orr and Poulter (1967). The line drawn through the ground census points is a third degree polynomial.

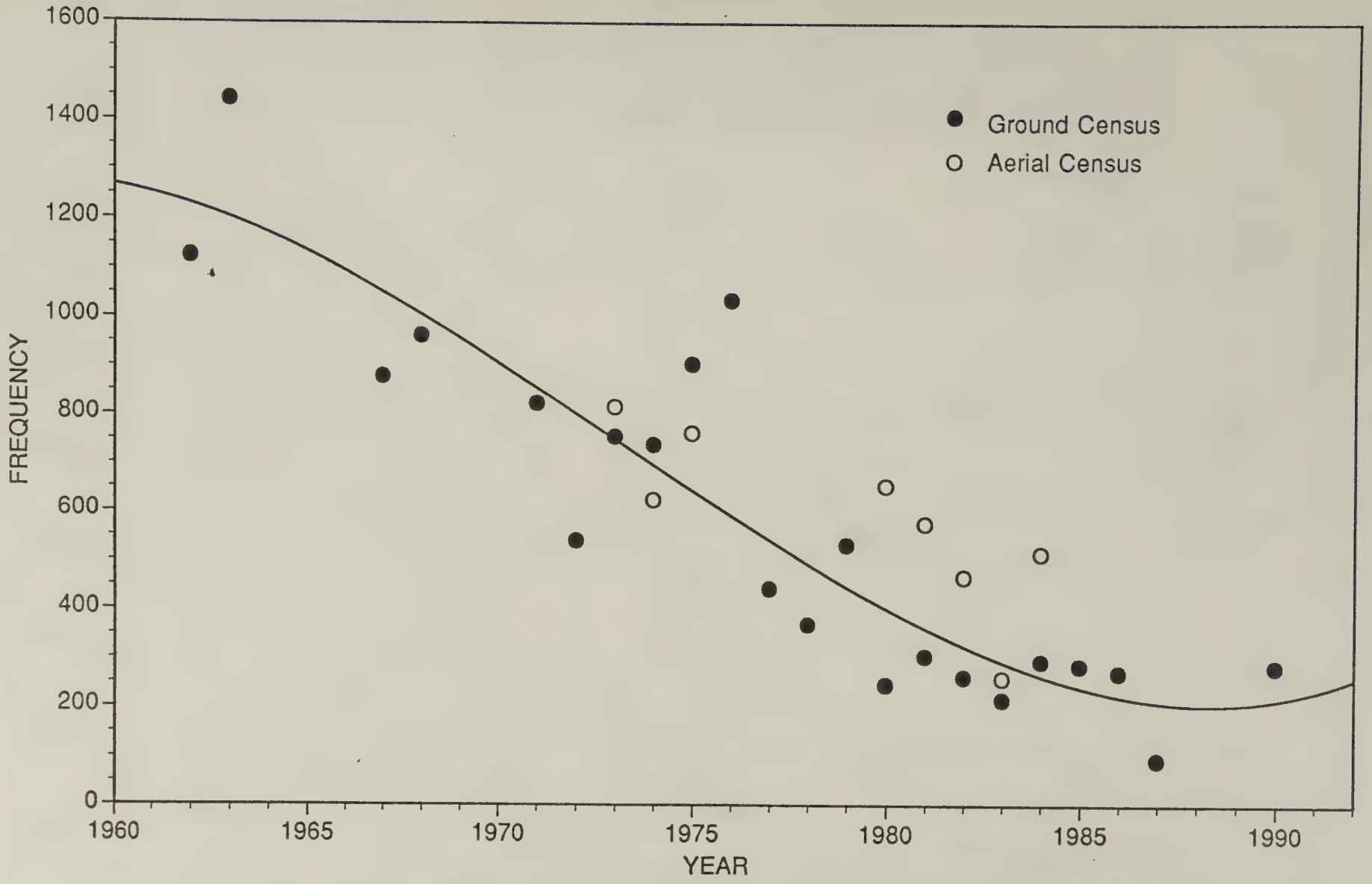

Figure 7. Peak breeding season counts of Steller females on Año Nuevo Island for the period, 1962-1990. A third order polynomial was fitted through ground counts obtained during the months of June, July or August. Censuses for the period, 1962 and 1963, are from Orr and Poulter (1967).

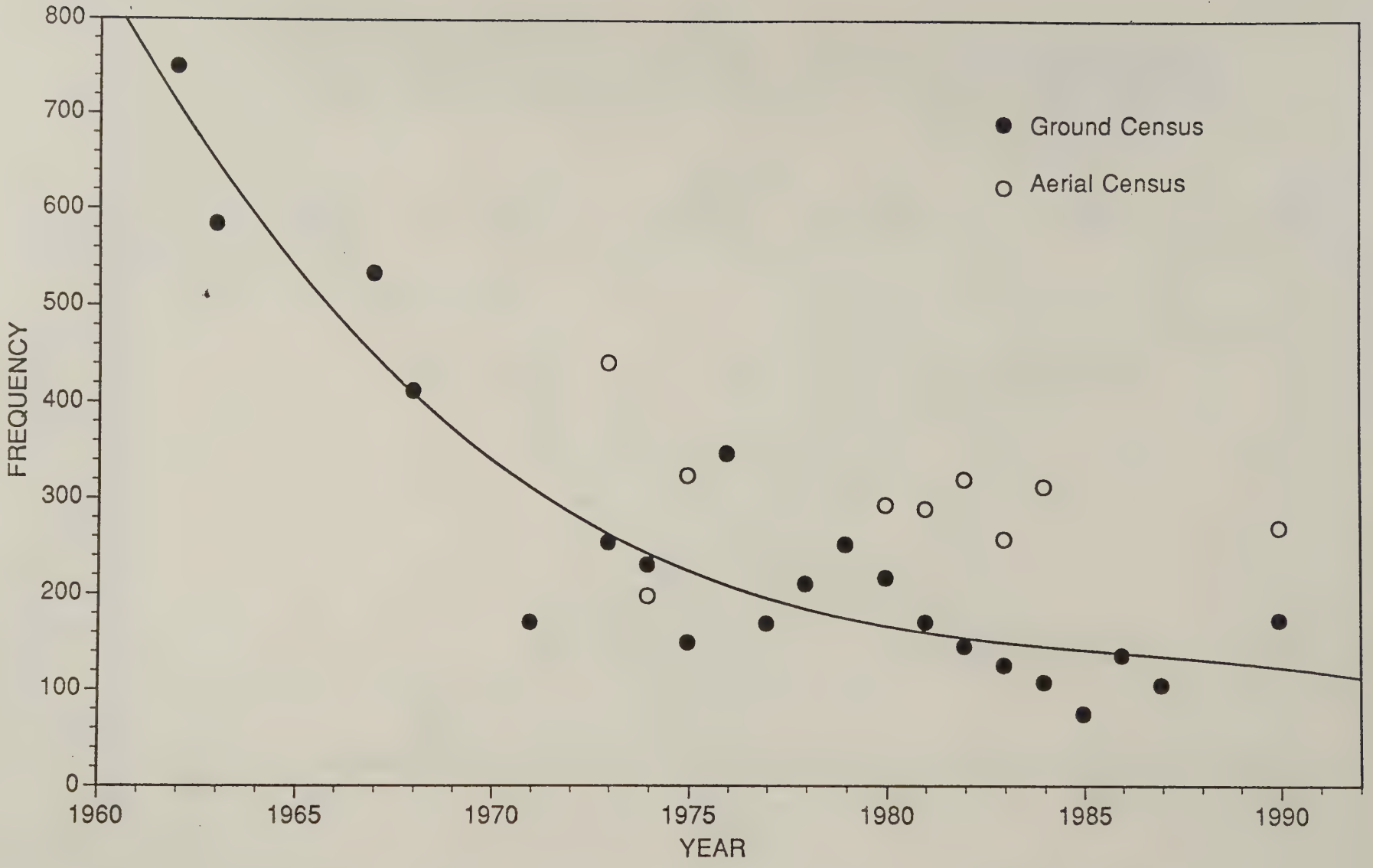

Figure 8. Peak breeding season counts of Steller pups on Año Nuevo Island for the period, 1962-1990. A third order polynomial was fitted through ground counts obtained in June, July or August. Censuses for the period, 1962 and 1963, are from Orr and Poulter (1967).

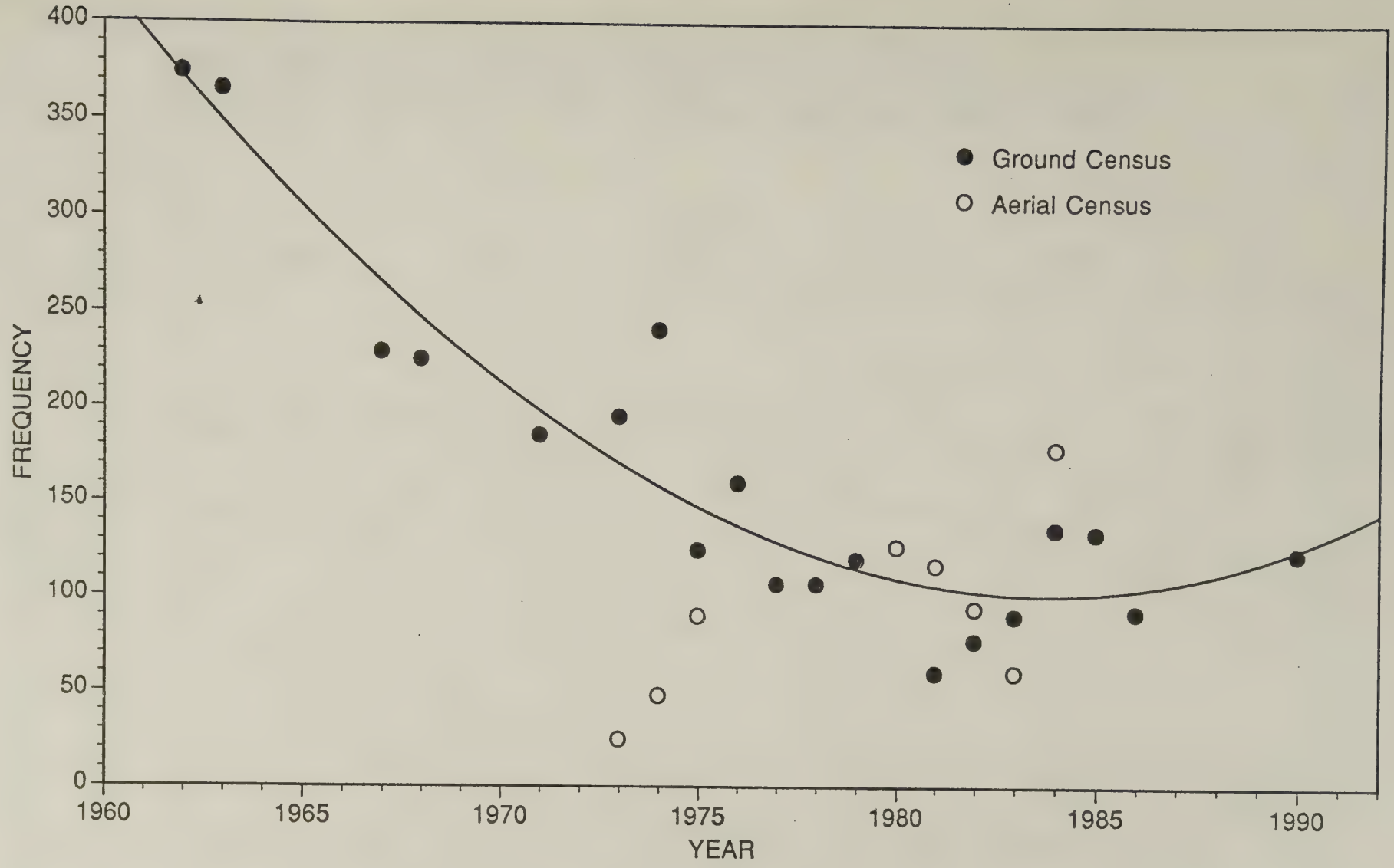

Figure 9. Peak breeding season counts of Steller males of breeding age on Año Nuevo Island for the period, 1962-1990. A third order polynomial was fitted through ground counts. Censuses for the period, 1962 and 1963, are from Orr and Poulter (1967).

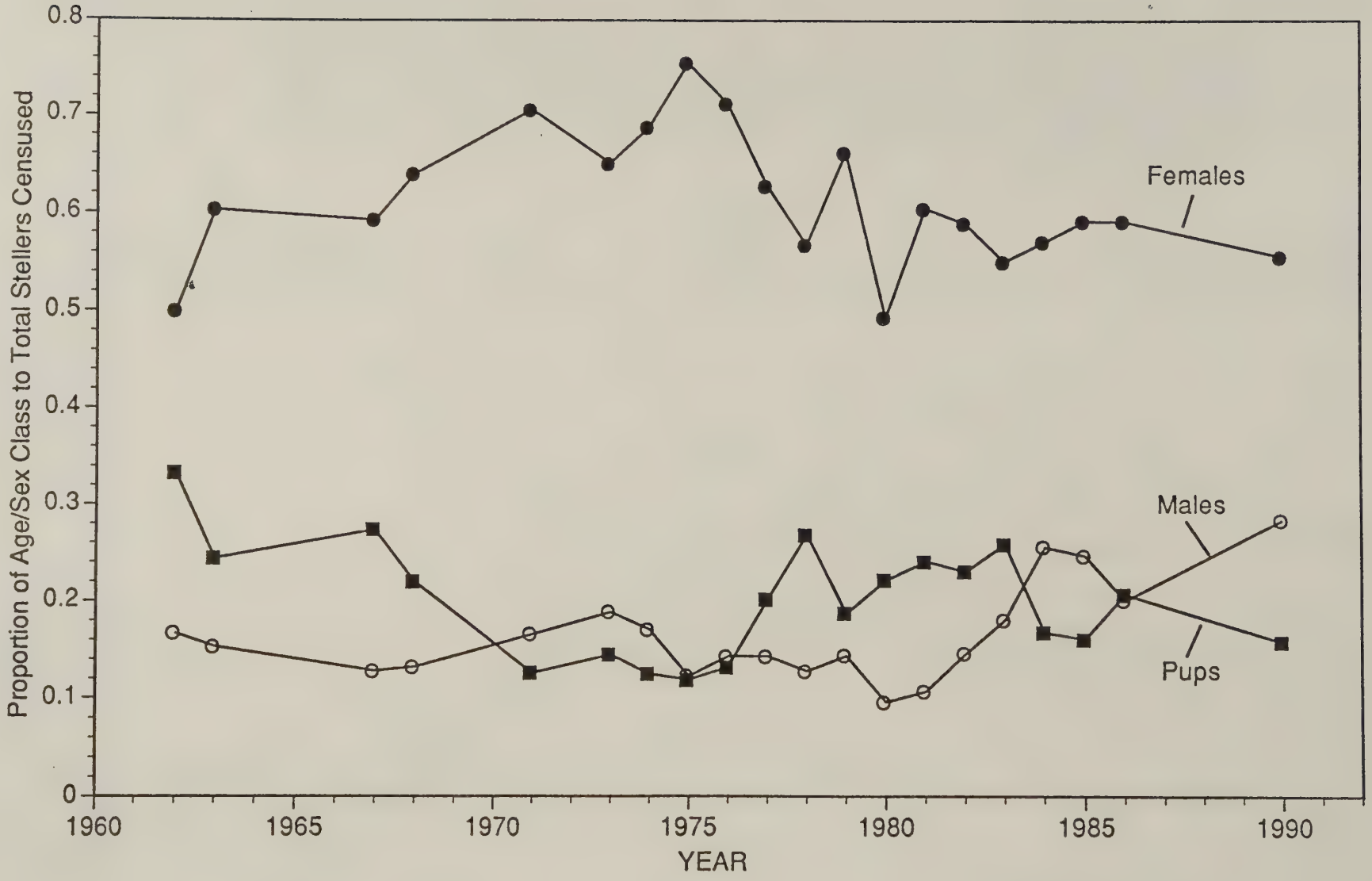

Figure 10. The proportion of females, males and pups to total animals censused at Año Nuevo Island during the years, 1962 to 1990. Data for 1962 and 1963 are from Orr and Poulter (1967).

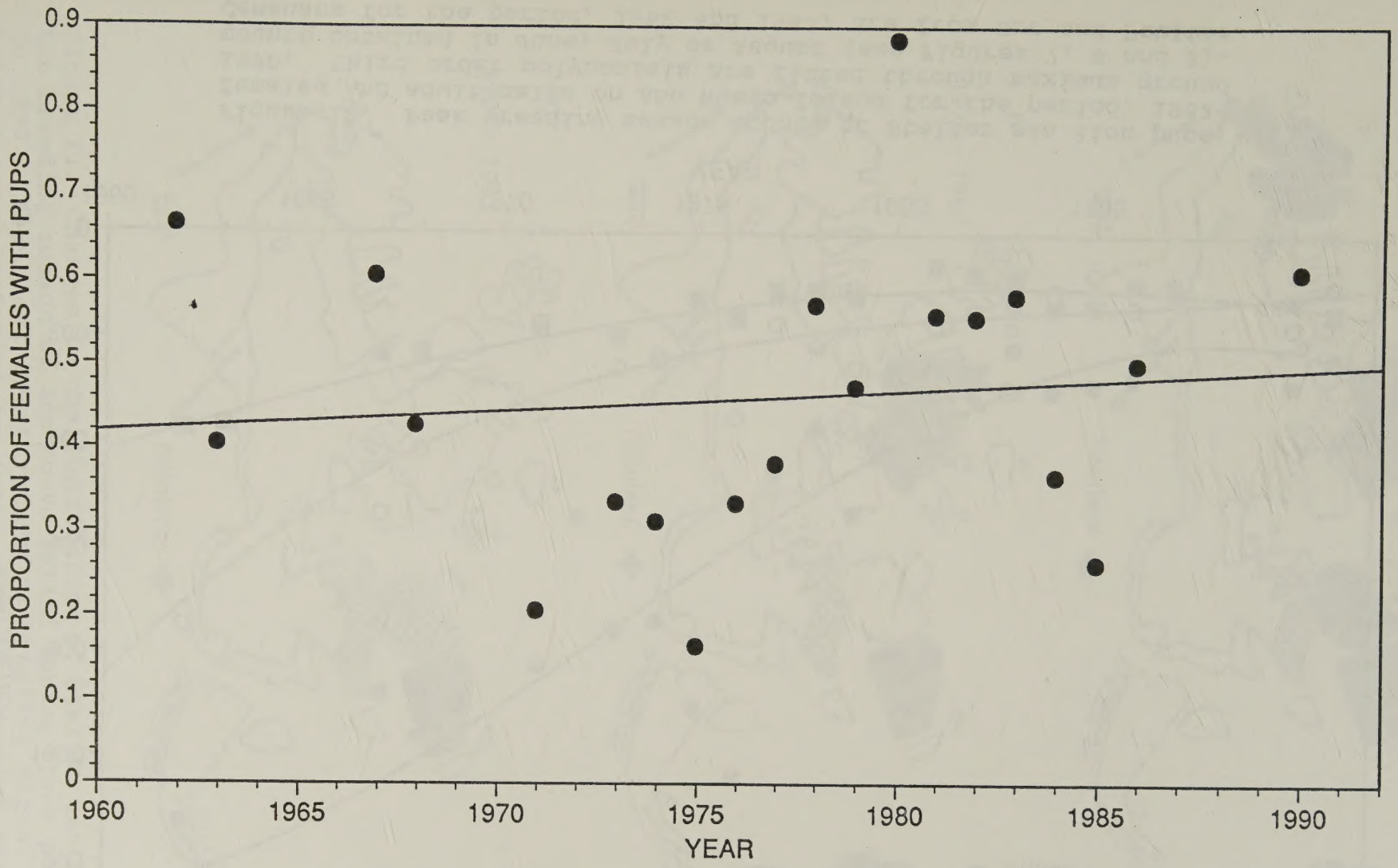

Figure 11. The proportion of females with pups to total females at peak season during the period 1962-1990. The regression line fits the equation, y = .453256 + .002526X.

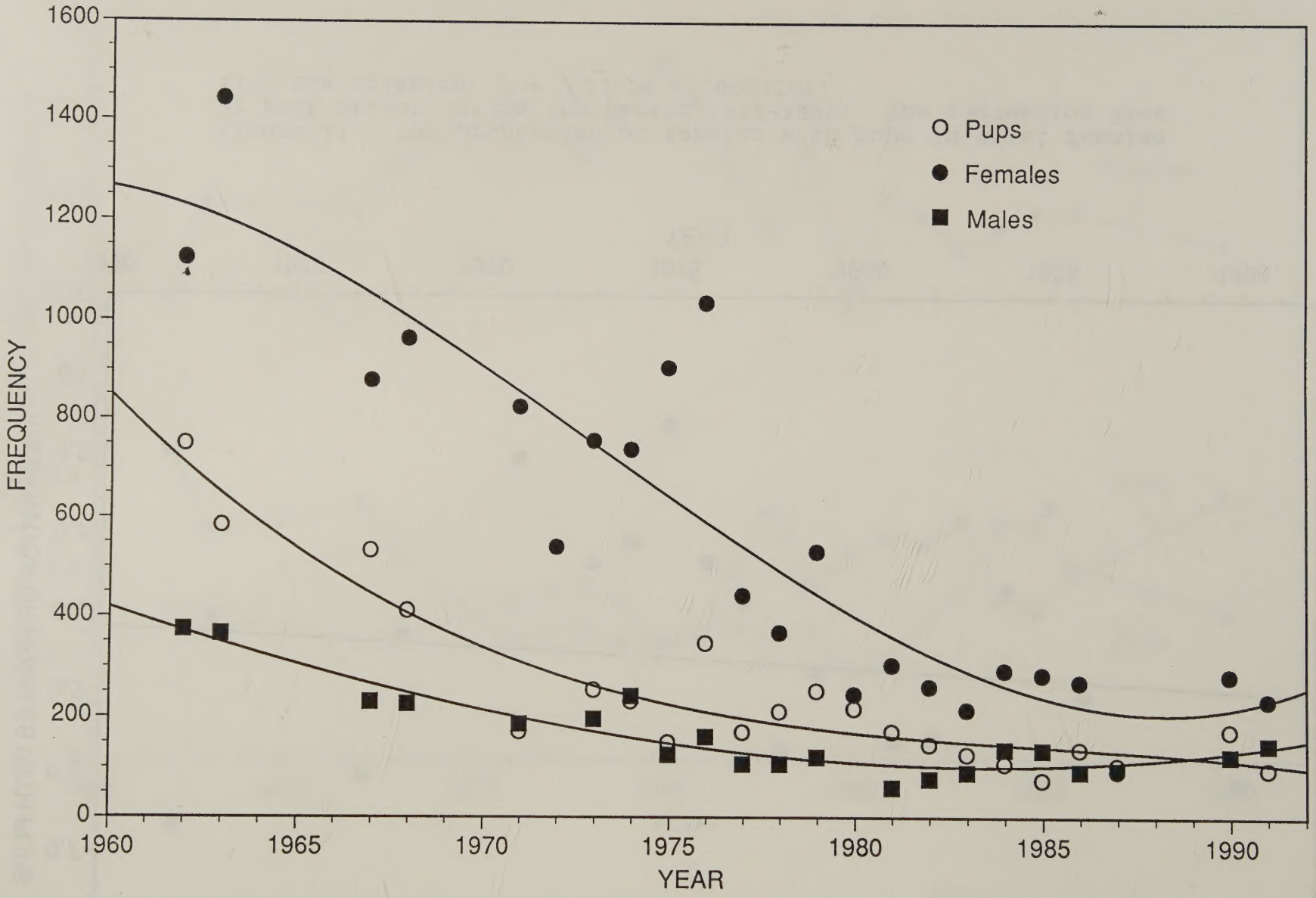

Figure 12. Peak breeding season counts of Steller sea lion pups, females and adult males on Año Nuevo Island for the period, 1962-1990. Third order polynomials are fitted through maximum ground counts obtained in June, July or August (see Figures 7, 8 and 9). Censuses for the period, 1962 and 1963, are from Orr and Poulter (1967).

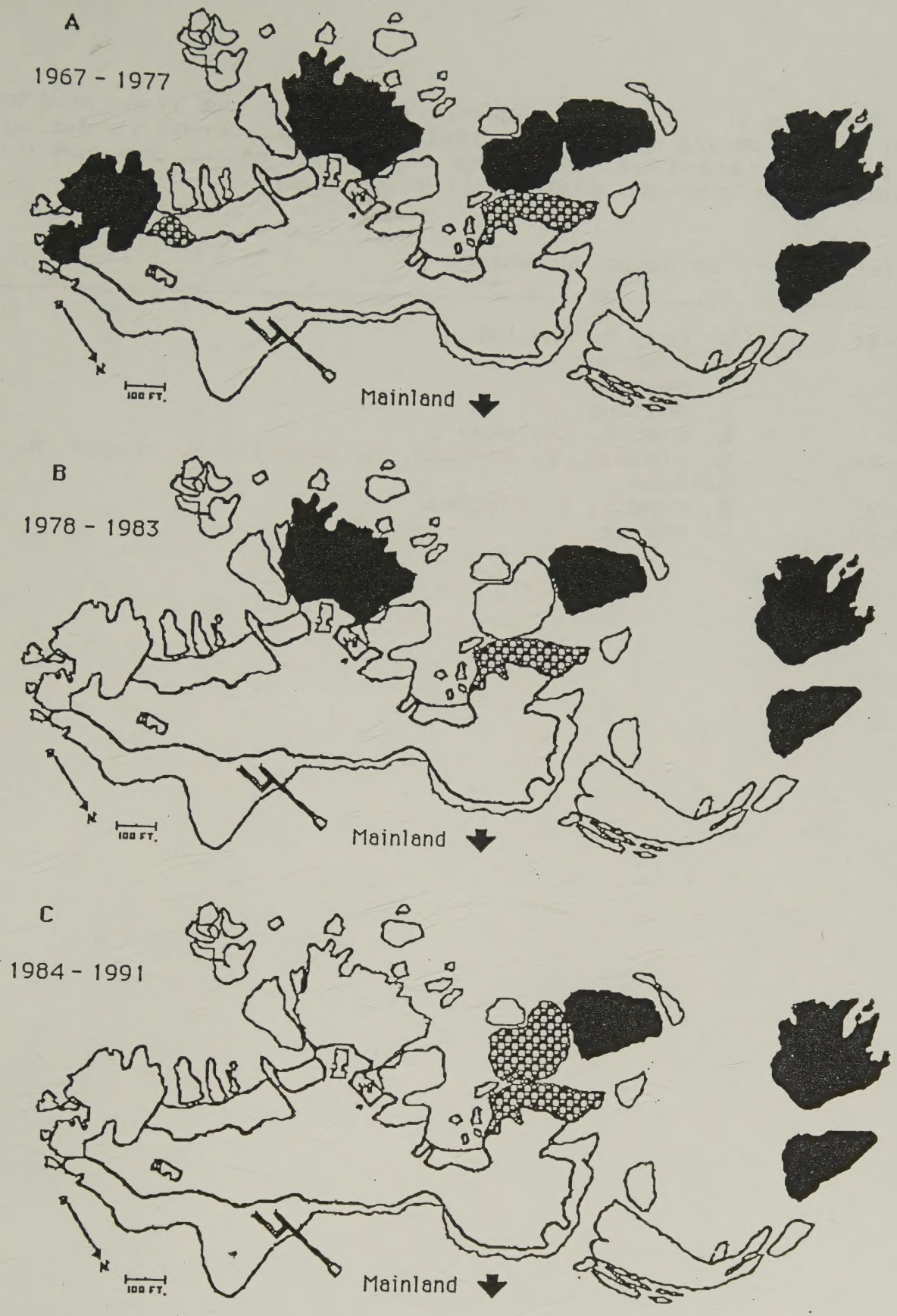

Figure 13. Changes in the distribution of Steller sea lions during the breeding season at Año Nuevo Island during three periods, 1967 to 1990. The black areas refers to breeding sites. The cross hatched areas referred to areas used as breeding sites in some years during the indicated period but not in others.

Appendix 1. Principal censuser of Steller sea lions at Año Nuevo Island during the period, 1961-1990. All censusers during the period, 1968-1990, with the exception of K. Ono and C. Calloway, were graduate students of B. Le Boeuf.

Year(s)	Principal Censusers
1961-64	R. Orr, T. Poulter
1967	R. Peterson
1968-71	R. Gentry
1972	R. Whiting
1973-	K. Ono, C. Calloway
1974-80	R. Gisiner, M. Pierson, M. Bonnell, K. Briggs, M. Reidman
1981-85	R. Condit, L. Higgins
1986-90	P. Morris